ARE "MATHOPHOBICS" BORN OR MADE? A CRITICAL INVESTIGATION OF THE CAUSES AND EFFECTS OF MATHOPHOBIA

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ABSTRACT

A critical examination of the causes and effects of mathophobia was the focus of this paper. It was conducted among 300 secondary school students in a South-western town of Ile-Ife where Obafemi Awolowo University is situated. Data on causes and effects of mathophobia were collected using mathophobia questionnaire and mathematics results of two terms for the subjects used for the study. Four hypotheses were tested on the causes of methophobia, influence of mathophobia on career interest and achievement in mathematics and influence of mathophobia on students mathematics achievement in various subject groups.

Data gathered were subjected to one way analysis of variance and t-test. It was found out that mathophobia is caused by many factors which reveals that mathophobia could be innate and environment caused. It was also found out that students who have aspirations for non science related career are more mathophobic than those with interest in science and commercial related disciplines. Mathophobia was also found out to negatively affect students achievement in mathematics. This effect on achievement was found to vary among Science, Commercial and Arts students.

All these results buttressed the existing findings in previous researches and support the trend of association between attitude towards mathematics and achievement in mathematics in the literature.

INTRODUCTION

Existence of mathophobia among secondary school students can no longer be doubted. Alao and Adeleke (2001) have recently not only established it's existence but also presented the prevalence of this negative attitude towards mathematics. Over the years, research interests have been focused on the likely outcomes of mahtophobia. A rather equally important concept that deserves attention is the causes of mathophobia.

Mathophobia as used by Gordon (1978) and quoted by Alao and Adeleke (2001) represents all those factors in an interactive constellation obviously resulting into an attitude of fear or hatred for mathemetics as a school subject. This invariably affects the beliefs about the students self and about mathematics (Ledar,1987).

Researchers have identified some variables that may be regarded as the causes of mathophobia or better still regarded as the resulting effect of mathophobia. O'brien and Kopala (1999) reported cases of mathematics self-efficacy, ethnic identity, gender and career interests as having interactions with students attitude towards mathematics. To that extent, it has been difficult separating discussions on the causes and effects of mathophobia. There can be initial causes on their own. Effects can also aggravate the state. A more or less reciprocal relationship between the two has been reported and emphasised by a number of studies (Ma, 1997; Loebl, 1993; Keeves, 1986; Feather, 1988; Meece, et al., 1990; Quinn and Jadar, 1987).

Some mediating variables have also been reported to exert some influence on students attitude towards, and achievement in, mathematics. Anderson (1981) reported that one of such variables is mathematics participation. The variable of mathematics participation however is a bit complex as it is determined not only by the learners intelligence level but also by some classroom physical and social environments-teacher handling of the subject matter, the nature of the concept or topic being discussed, the nature of assessment the students look forward to and some other undefined conditions. Much as these variables go into determining what attitude students have towards mathematics, the attitude students have towards mathematics, in turn may also be responsible for some outcomes. These

may include achievement (Ma, 1997, Zimmerman Bandura and Martinez-Pons, 1992) Career interest (Lient, et al., 1991; Hyde, et al., 1990).

The objective of this paper is to identity those factors reported by mathematics learner of South western Nigeria as being responsible for their state of mathophobia and the effects methophobia has on their mathematics achievement and career interest. Some of the variables of interest to this study are the degree of mathophobia exhibited by the students and the extent to which mathophobia influences the nature of career aspiration a student has. Degree of mathophobia in the context of this paper connotes the extent to which a mathophobic student hates slightly or out rightly or fears slightly or out rightly, or combines both hatred and fear for mathematics. The other variable, the spread of mathophobia among various career aspirants stands for how much the fear or dislike for mathematics is entrenched among students who aspire to take up various professions.

It was therefore hypothesised that

1. There is no significant difference in the degree of mathophobia among students arising from different causes.
2. There is no significant difference in the spread of matbophobia among various career aspirants.
3. There is no significant difference between the achievement of mathophobic and non-mathophobic students.
4. There is no significant difference among the mathematics achievement of mathophobic Arts, Commercial and Science students.

Methodology

300 students were randomly selected (simple random) from five secondary schools that were also randomly selected in Ife Central Local Government Area of Osun State. The sample consisted of fifty students from each school with ten students from each class from Junior Secondary School (JSS1) to senior secondary school III (SSS III). There were three public schools and private schools among the school selected. The sample was in the ratio of 170 to 130 of boys to girls.

A twenty seven item questionnaire tagged student phobia for mathematics Questionnaire (SPMQ) consisting of section A on personal data (Six item) and section B on attitude towards mathematics (twenty one items) was administered on the subjects for data collection on one part and the students result in mathematics examinations for two consecutive terms were also collected on the other part. The questionnaire was designed by the authors with the assistance of two other colleagues – an educational psychologist and a mathematics educator. Administration of the questionnaire was with the assistance of the mathematics teachers in the schools used. The responses were scored 4,3,2,1 or 0 according as strongly agreed, agreed disagreed, strongly disagreed or undecided. This order was used because of statements of the items of the questionnaire were written in a way to connote a sense of mathophobia if it is at least agreed to. The maximum score obtainable was 80 and a minimum of 0 if a respondent is undecided on all the items. If a respondent just disagreed with all the items he/she would have a maximum score of 40, which was regarded being non-mathophobic.

In testing the hypothesis, it was only in hypotheses 1 and 3 that the responses of all the respondents were used. For the hypotheses 2 and 4 only the copies of the questionnaires responded to by the senior secondary classes were used. It is only at this level that we can differentiate between subject groups being offered (Science, Commercial or Arts). Likewise it is at this level that students seriously begin to aspire for careers.

Hypotheses, 1 and 4 were tested using a one way analysis of variance while hypothesis 3 was tested using t-test analysis. All hypotheses were tested at 0.05 level of confidence.

Results and Discussion

The succeeding tables present the results of the investigation of the causes of mathophobia, its effects on achievement and career choice using ANOVA, simple percentage and t-test analyses.

To test whether there is significant difference in the degree of Mathophobia among students arising from different causes data collected were subjected to one-way analysis of variance. This analysis was adopted because the scoring given the items of the questionnaire has converted the scores obtained into quantitative data representing the position of each subject on the mathophobia scale. The comparison of these scores was done among four groups. The groups are those of students who claimed that their hatred or fear for mathematics is as a result :

1. teacher's conduct and teaching methodology

2. nature of mathematical knowledge assessment ("you miss the answerYou miss all")
3. nature of the discipline of mathematics itself (abstractness)
4. inexplicable factors (age long notion that mathematics is difficult. The results are as presented in table 1.

Table 1
ANOVA summary of the difference in the degree of mathophobia arising from different causes.

Source	SS	Df	Ms	F
Between	5486.43	3	1828.81	
Within	40560	169	240	7.62
Total	40046.43	172		

P<0.05

Four major causes were identified by the subjects as being responsible for their state of mathophobia. They are reasons arising from teacher's conduct and teaching methodology, reasons arising from mathematical knowledge assessment, those arising from the nature of the discipline of mathematics and those arising from factors that can not be defined. Statistical analysis however showed that there is a significant difference in the degrees of mathophobia among students arising from these different causes (Fc = 7.62, df = (3,169) Ft = 3.07). research reports have indicated that many factors may be responsible for students measures of attitude towards mathematics and consequently, or vice versa, achievement in mathematics (Anderson, 1981; Hayduk, 1987;Hyde, et al., 1990; Ma, 1997).

This finding suggests that the task of assisting learners to overcome phobia in the learning of mathematics is a big challenge to the teachers, as a lot is to be done in various dimensions. The teacher is to re-examine his personalities and teaching strategies; He is not to give the impression that passing or failing mathematics examinations is the determinant of the learners lives. He is also to "market" mathematical knowledge as a good that any one who cares can purchase.

To test the hypothesis that there is no significant difference in spread of mathophobia among various career aspirants, data were collected in the career areas of Accounting/Banking, Medicine/Nursing, Engineering Law, Civil Service, Lecturing/Teaching and others. Responses were available only in the areas of the first four and the last options and data so collected were subjected to one-way analysis of variance. Like the first hypothesis, scores obtained on this hypothesis have been converted to quantitative data due to the nature of the scoring used.

The results are as presented in table 2.

Table 2
ANOVA summary of the degrees of mathophobia across career aspirants.

Source	SS	Df	'MS	F
Between	18660.10	4	4665.03	17.92
Within	25251.04	97	260.32	
Total	43911.14	101		

P < 0.05

Simple mean difference indicated that the degrees of mathophobia vary increasingly among career aspirants in the order of Medical Doctor (38) Accountant/ Banker (40.38) Others (41) Engineers (41.5) and Lawyers (48.85). One way ANOVA further revealed a statistically significant difference in this spread (Fc = 7.92, df = (4,97) Ft = 3.07). This phenomenon can be attributed to the realisation of the importance of mathematics in some of these various careers. However the question as to whether it is the ambition for a particular career that determines the learners attitude toward mathematics or it is the attitude towards mathematics that suggests the career of interest remains largely unanswered. Although O'brien and Kopala (1999) have quoted literature that deficits in self efficacy or self-perceived skills in mathematics may be responsible for some individuals not aspiring for science and engineering related careers. Zimmerman, et al., (1992) have also reported the existence of the role of self-efficacy beliefs on self-motivation for academic attainment and personal goal setting among adolescents. This has also been corroborated by the findings of Lent, et al., (1991; 1993) who found that self efficacy mediates the effects of prior performance on motivation and that motivation, in turn, mediates the effect of self efficacy on career selection.

The test of the hypothesis that there is no significant difference between the mathematics achievement of mathophobic and non-mathophobic was done with t-test analysis. And the results are contained in table 3.

Table 3

t-test analysis of the difference in performance between mathophobic and non-methaphobic students.

Group	N	X	S.D	t
Mathophobic	123	42.14	11.21	20.97
Non-mathophobic	173	66.32	7.34	

P<0.05

Simple means revealed a difference in the mathematics achievement of mathophobic and non-mathophobic students. The non-mathophobic group has a higher achievement of 66.32 as against the mathophobic group of a mean score of 42.14. T-test analysis further showed that the difference is statistically significant as 0.05 level of confidence. Wide range of research reports have severally indicated this occurrence (Ma, 1997; Loebl, 1993, Randhawa, et al., 1992; Meece, et al., 1990). What is still not settled as reported by researchers is when attitude/phobia in this case) affects achievement, or achievement causes the phobia or the two interact with each other to influence each other.

In table 4, the degrees of Phobia as expressed by students pursuing Science Arts and Commercial were tested using one way ANOVA.

Table 4

ANOVA summary of the difference in the mathematics achievement of mathophobic Science, Arts and Commercial students

Source	SS	Df	MS	F
Between	3214	2	1607	30.95#
Within	5294	101	51.92	
Total	8508			

P<0.05.

A significant difference was found among the achievement of mathophobic Science, Commercial and Arts students (Fc = 30.95, df (2.101) Ft = 3.07, p < 0.05). The difference , increasingly, is in the order of Arts (X = 40.22), Commercial (X =- 51.16) and Science (X = 68.24) students. This finding suggests that despite being mathophobic inclination of students towards mathematically oriented discipline still exerts some degree of influence on their achievement in mathematics. It further buttresses the fact that mathophobia may not be total but rather a question of some topics, concepts or even tasks, which would account for varied degrees of mathophobia. Hence two students may be regarded as being mathophobic but still have varied achievement in mathematics. It is a challenge for the teachers therefore.

Conclusion

This study has identified that the conduct of teachers and their teaching methodology, the nature of assessment that some teachers give in mathematics lesson, the abstract nature of mathematics itself and some factors that can not be explained such as the age long notion that mathematics is a difficult subject, are all possible causes of mathophobia. The study has also pointed out that hatred or fear for mathematics affects the decision of a student to aspire for a career that requires mathematics or not. And such fear and hatred affect performances in mathematics. It is also observed that the degree to which individual student exhibits phobia for mathematics varies. The teacher therefore holds it a duty to handle mathematics in a way as to reduce their level of phobia for the subjects consequently reducing the effects it produces. Because effects of mathophobia can still be more causes of mathophobia.

References

1. Alao, K. A. and Adeleke, M. A. (2001). A Study of the Prevalence and Factors Influencing Phobia for Mathematics among Nigerian Secondary School Students. An unpublished Research Monograph, Faculty of Education, Obafemi Awolowo University, Ile-Ife.

2. Anderson, R.E. (1981). Measurement Properties of attitude scales in the National Assessment of Educational Progress data on mathematics Final report). Minneapolis: Minnesota Center for Social Researchs.

3. Feather, N.T. (1988). Values valences, and course enrolment: Testing the role of personal values within an expectancy – value framework. Journal of Educational Psychology, 80, 381 – 391

5. Hyde, J.S., Fenneng, E. and Ryan, M. (1990). Grade Comparisons of Mathematics attitudes and affect: A meta-analysis. Psychology of Women Quarterly, 14, 299-224.

6. Hyde, J.S., Fennema, E. and Lamon, S.J. (1990). Gender differences in Mathematics performance. A meta-analysis. Psychological Bulletin, 107, 139-155.

7. Keeves , J.P. (ed) (1986) Aspirations, motivation and achievement: Different methods of analysis and different results (special issue). International Journal of Educational Research. 10(2)

8. Lent, R.W., Lopez, F.G. and Bleschike, K.J. (1991). Mathematics self-efficacy: Sources and relation to science – based career choice. Journal of Counselling Psychology, 38, 424-430.

9. Lenth, R.W., Lopez, F.G. and Bieschike, K.J. (1993). Predicting Mathematics – related choice and success behaviours: Test of an expanded social cognitive modal. Journal of Vocational Behaviour, 42, 123 – 236.

10. Loebl, M.K., (1993). A Causal Modal of variabvles predicting mathematical achievement in first – grade Children (spatial ability, problem-solving) (Doctoral dissertation, Fordham University, 1990). Dissertation Abstracts International, 54, 463.

11. Ma, X. (1997). Reciprocal Relationships Between Attitude Toward Mathematics and Achievement in Mathematics. The Journal of Educational Research, 90 (4), 221-229.

12. Meece, I. Wigfield, A. and Eccles, J.S. (1990). Predictors of Math anxiety and its influence on young adolescents' course enrolment intention, and performance in Mathematics. Journal of Educational Psychology 82, 60-70.

13. O'brien, V. and Kopala, M. (1999). Mathematics self-Efficacy, Ethnic Identity, Gender, and Career Interests Related to Mathematics and Science. The Journal of Educational Research, 92(4), 231-235.

14. Quinn, B., and Jadav, A.O. (1987). Causal relationship between attitude and achievement for elementary grade mathematics and reading. The Journal of Education Research, 80, 366-372.

15. Randhawa, B.S., Bearer, J.E. and Lundberg, I. (1992). Gender similarities in a structural model of mathematics achievement. Unpublished manuscript. University of Saskatchewan, Saskatoon.

16. Zimmerman, B. Bandura, A. and Martinez-Pous, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. American Educational Research Journal, 29, 663 – 676.